Open Journal of Epidemiology, 2021, 11, 56-69
https://www.scirp.org/journal/ojepi
ISSN Online: 2165-7467
ISSN Print: 2165-7459

Epidemiological Characteristics of COVID-19 Confirmed Cases in Muscat Governorate, Sultanate of Oman

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How to cite this paper: Al Balushi, L., Al Fahdi, F., Al Ghafri, T., Amin, M., Singh, J., Al Siyabi, B., Al Kalbani, M., Al Kindi, M., Al Balushi, F., Al Ghazaili, H., Al Alwai, M., Al Mashari, S., Al Kindi, H., Al Rumhi, A., Al Shidhani, I., Al Balushi, Z., Kurup, P.J. and Al Ajmi, F. (2021) Epidemiological Characteristics of COVID-19 Confirmed Cases in Muscat Governorate, Sultanate of Oman. *Open Journal of Epidemiology*, 11, 56-69.
https://doi.org/10.4236/ojepi.2021.111006

Received: December 6, 2020
Accepted: February 1, 2021
Published: February 4, 2021

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Abstract

Introduction: The coronavirus disease 2019 (COVID-19) was declared as pandemic by WHO by March 11th. First case reported in Oman was on 24th February 2020 and later the country went through stages of epidemic progression. This study describes the sociodemographic and epidemiological characteristics of confirmed COVID-19 cases in Muscat governorate and related outcomes. **Materials and Methods:** This is a descriptive, exploratory analysis of all lab confirmed COVID 19 cases that were reported from 1st February to 31st May 2020. Data for the study was primarily extracted from notifications system established for surveillance (Tarassud). Secondary data sources were, contact listings and hospital medical records. **Results:** 11,648 initial cases of confirmed COVID-19 infections were included. The mean age was 35 years, 84.7% (N = 9862) were males, 25.9% (N = 3017) were Omanis, and 74.1% (N = 8631) were expatriates of which Indian origin were the majority (37%). Fever and cough were the most common presentations (46.3% and 29.5% respectively). Diabetes and hypertension were the most common comorbidities (4.9% and 4.6% respectively). Hospital admission was required for 7% (N = 811) of the total reported cases, out of them 171 cases (21%) were admitted to ICU, where 107 (13.2%) were ventilated. The case fatality rate (CFR) was 0.9%. 158 clusters containing 2949 contacts were identified from case records and categorised into 3 groups based on their exposure settings. The incubation period measured was 8 days (IQR 4.0 - 15.0) for workplace, 8 days (IQR 4 - 17) for dormitory and 4 days (IQR 2.0 - 7.0) for family groups. The secondary attack rate (SAR) estimated was 41.6% (95% CI: 0.34 - 0.48), 52% (95% CI: 0.40 - 0.63) and 33% (95% CI: 0.27 - 0.38) for workplace, dormitory and family groups, respectively. **Conclusion**: Results of this study, determine the transmission trend of COVID-19 in a country with high immigrant population. These findings could be utilised for further response planning in similar settings.

Keywords

COVID-19, Epidemiological Characteristics, Infectious Disease, Cluster

1. Introduction

The current pandemic of coronavirus disease 2019 (COVID-19) began in Wuhan city last December 2019 and spread rapidly throughout China and the world [1]. WHO declared the disease a public health emergency of international concern (PHEIC) on 30 January 2020, and a pandemic on 11 March 2020 [2]. COVID-19 is caused by SARA-CoV2, a single-stranded enveloped RNA virus belong to the genus betacorona [3].

As of May 31st, 2020, the disease affected almost 6 million people and caused 367,166 deaths globally [4]. SARA-CoV2 could cause clusters of severe infection similar to that of SARS-CoV [3] [5] [6]. The clinical presentation ranges from being asymptomatic to severe infections. Around 80% of the infected cases have mild symptoms [6] [7]. However, 7% - 12% of individuals progress into severe illness requiring critical care management that includes ICU admissions and mechanical ventilation [8] [9].

Mortality from the disease is more prevalent in the elderly and those with underlying pre-existing conditions [8] [9].

On 24th February 2020, Department of Disease Surveillance and Control (DSC), Muscat Governorate, received notification from the reference Central Public Health Laboratory (CPHL) confirming COVID-19 in two travellers who returned from the Islamic Republic of Iran. By 26th March, the total number surged over 100 [10], and local transmission of the disease was evident. The first death was reported on 31st March 2020. The patient was a 72-year-old citizen [11], who worked as a seller in a traditional Market which is attended by many tourists.

Based on the alert issued from WHO, several prompt interventions were undertaken by the Ministry of Health as preparedness for COVID-19 pandemic. These include initiation of surveillance at point of entry for travellers coming from the affected countries and quarantining them for 14 days, increasing the capacity of the CPHL for testing suspect cases, distribution of testing guidelines, infection prevention and control protocols, algorithms for suspected case definition and testing was issued and distributed to all relevant health institutions. Health promotion activities targeting the community were also commenced that promoted hand hygiene, avoiding public gathering and social distancing.

Laboratory confirmation of SARS-CoV-2 was performed at the CPHL, and subsequently in certified tertiary care hospitals. RT-PCR assays were performed in accordance with the protocol established by the WHO [3] [12] [13] [14].

Suspect case definitions were periodically reviewed to adapt local epidemiology and developments in diagnostic testing for COVID-19. However, a definition for a confirmed case remained unchanged as a case tested positive by RT-PCR test.

The current study aims to describe the sociodemographic and epidemiological characteristics of confirmed COVID-19 cases in Muscat governorate and the related outcomes.

2. Materials and Methods

2.1. Study Setting

Muscat Governorate is the capital of the Sultanate of Oman. The 2018 mid-year population of the Country was 4,601,706. Muscat has the highest population density with a population of 1.4 million, of which 64% are expatriate population [15], where significant proportion are workers who lived in a dormitory setting. The major point of entry to Oman is the Muscat International Airport which caters to around 15 million passengers per year [16]. Thus, the threat of the importation of the disease was highest in Muscat.

2.2. Methods

This is a descriptive, exploratory analysis of all lab-confirmed COVID 19 cases that were reported from 1st February to 31st May 2020. Data for the study was extracted primarily from the Ministry of Health electronic notifications system "Tarassud" and paper notifications from few institutions that had limited access to "Tarassud". The electronic and paper notification forms contain information about the patients' Sociodemography, in addition to disease signs and symptoms, symptom onset date, risk factors, comorbidities, source of infection and disease outcome. Admission date, discharge date, ventilation use and the outcome data of the admitted patients were extracted from hospital records. All SARS-CoV2 confirmed cases diagnosed from February 2020 until the end of May 2020 in Muscat Governorate were included in the study.

2.3. Statistical Analysis

Data were entered into a spreadsheet and analysed using Statistical Package for Social Sciences (SPSS) for Windows, version 20.0 software (SPSS Inc., Illinois, USA). The epidemic curve was constructed and interpreted, in addition to the descriptive statistics of clusters and exposure. Numbers and percentages were used to describe sociodemographic characteristics and age groups, in addition to disease symptoms, comorbidities and risk factors. Mean (±standard deviation. SD) were used to describe age, duration of illness and length of hospital admission. Independent t-test was used for comparison of means, chi-square tests for comparison of proportions. For all tests, p-value ≤ 0.05 was considered significant. Bivariate analysis associated with admissions (severity) and among admitted, using multi-linear regression model attempted to identify factors that led to increased duration of admission.

2.4. Ethical Approval

Ethical approval was obtained through the ethical committee of Muscat governorate, Directorate General of Planning and Studies at the Ministry of Health. Anonymous data already available at the established notification process for COVID-19 were collected.

3. Results

3.1. Social and Demography

The total number of samples taken for SARS CoV-2 testing from February 2020 until the end of May 2020 was 37,615 samples, out of which 11,648 (30.9%) have been tested positive for COVID-19. The mean age of confirmed cases was 35 years (±12.9 SD) and ranged from 3 months to 94 years (**Table 1**). Out of the total cases, 84.7% (N = 9862) were males and 15.3% (N = 1786) were females. Of the total cases, Omanis constituted 25.9% (N = 3017), while 74.1% (N = 8631) were expatriates. The proportions of the major affected foreign nationalities were Indian (37%), Bangladeshi (23.3%) and Pakistani (6.1%). Age group from 21 to 40 years was the most affected group (N = 7343, 63%).

As shown in (**Figure 1**), cases started to increase gradually in early May to reach a surge by the end of the month to exceed 500 cases daily. The first reported death from disease was on 31st March 2020 and by the end of May, the total fatalities reached 103 cases, out of them 88 (85.4%) were males and 31 (30.1%) were Omanis. The case fatality rate (CFR) was 0.9%. As of 31st May, 8435 cases (72.4%) have recovered and 3110 (26.7%) remain active. **Figure 2** compares incidence rates per 100,000 between Omanis and expatriates. As shown in the figure, at the initial phase, the number of infected expatriates outnumbered Omanis. Later, the diseases affected the Omani population in nearly similar rates.

3.2. Clinical Presentation

Clinical presentations of most cases were mild to moderate, with 6.9% (N = 808) asymptomatic. Fever and cough were the most common presentations (46.3% and 29.5% respectively). 15.6% of cases had one or more associated comorbidities or risk factors. Diabetes and hypertension were the most common co-morbidities (4.9% and 4.6% respectively) and smoking was the most common risk factor (4.6%) (**Table 2**).

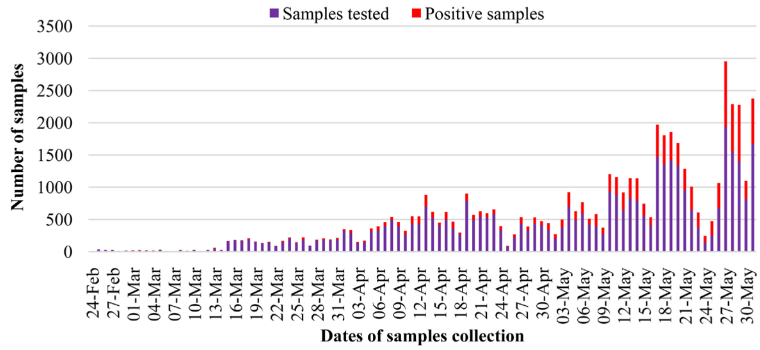

Figure 1. Total COVID-19 Total tested and positive cases per notification date in Muscat.

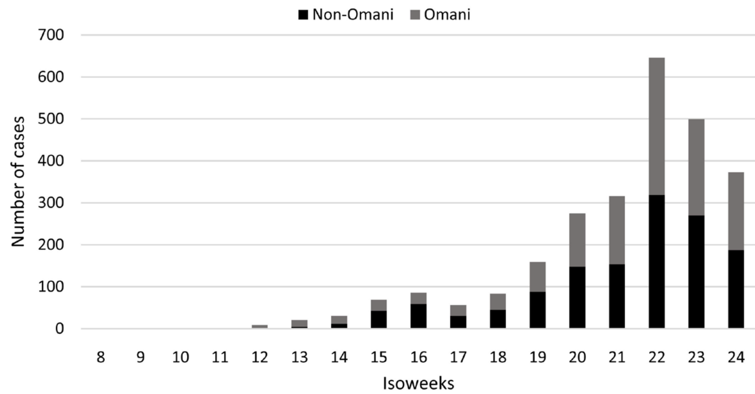

Figure 2. Comparison of the weekly incidence per 100,000 between Omanis and expatriates.

Table 1. Socio-demography of COVID-19 reported cases in Muscat.

	Omani N (%)	Non-Omani N (%)	Total N (%)
Gender			
Males	1766 (15.2)	8096 (69.5)	9862 (84.7)
Females	1251 (10.7)	535 (4.6)	1786 (15.3)
Age groups			
0 - 20 Years	614 (5.3)	334 (2.9)	948 (8.1)
21 - 40 Years	1605 (13.8)	5738 (49.3)	7343 (63.0)
41 - 60 Years	604 (5.2)	2378 (20.4)	2982 (25.7)
Above 60 Years	194 (1.7)	181 (1.6)	375 (3.2)
Residence			
Mutrah	502 (4.3)	3786 (32.5)	4288 (36.8)
Seeb	1514 (13.0)	2140 (18.4)	3654 (31.4)
Bowshar	396 (3.4)	2288 (19.6)	2684 (23.0)
Muscat	86 (0.7)	299 (2.6)	385 (3.3)
Amerat	409 (3.5)	52 (0.4)	461 (4.0)
Quriyat	59 (0.5)	5 (0.04)	64 (0.5)
Other regions	51 (0.4)	61 (0.5)	112 (1.0)

Table 2. Factors associated with disease severity.

	Total N (%)	Not admitted N (%)	Admitted N (%)	p values
Age groups				
0 - 20 Years	948 (8.1)	934 (98.5)	14 (1.5)	<0.01
21 - 40 Years	7343 (63.0)	7000 (95.3)	343 (4.7)	
41 - 60 Years	2982 (25.6)	2666 (89.4)	316 (10.6)	
>60 Years	375 (3.2)	237 (63.2)	138 (36.8)	
Gender				
Males	9862 (84.7)	9203 (93.3)	659 (6.7)	<0.01
Females	1786 (15.3)	1634 (91.5)	152 (8.5)	
Nationality				
Omani	3017 (25.9)	2749 (91.1)	268 (8.9)	<0.01
Expatriates	8631 (74.1)	8088 (93.7)	543 (6.3)	
Symptoms*				
Fever present	5394 (46.3)	4903 (90.9)	491 (9.1)	<0.01
Fever absent	6254 (53.7)	5934 (94.9)	320 (5.1)	
Cough present	3438 (29.5)	3064 (89.1)	374 (10.9)	<0.01
Cough absent	8210 (70.5)	7773 (94.7)	437 (5.3)	
Breathlessness	507 (4.4)	317 (62.5)	190 (37.5)	<0.01
No Breathlessness	11,141 (95.6)	10,520 (94.4)	621 (5.6)	
Comorbidities				
Diabetes-Yes	572 (4.9)	407 (71.2)	165 (28.8)	<0.01
Diabetes-No	11,076 (95.1)	10,430 (94.2)	646 (5.8)	
Hypertension-Yes	534 (4.6)	373 (69.9)	161 (30.1)	<0.01
Hypertension-No	11,114 (95.4)	10,464 (94.2)	650 (5.8)	
Risk factors**				
Smoking-Yes	530 (4.6)	492 (92.8)	38 (7.2)	0.84
Smoking-No	11,118 (95.4)	10,345 (93.0)	773 (7.0)	
Alcohol use-Yes	88 (0.8)	77 (87.5)	11 (12.5)	0.04
Alcohol use-No	11,560 (99.2)	10,760 (93.1)	800 (6.9)	
Obesity	84 (0.7)	60 (71.4)	24 (28.6)	<0.01
No Obesity	11,564 (99.3)	10,777 (93.2)	787 (6.8)	
Duration of illness (Median & Inter quartile range)				
Omani	5 (IQR 3 - 8)	5 (IQR 3 - 8)	11 (IQR 6 - 20)	
Expatriates	3 (IQR 1 - 6)	3 (IQR 1 - 6)	6 (IQR 2 - 10)	

*Other symptoms included Myalgia (N = 1376, 11.8%), Abdominal pain, Nausea and vomiting (N = 97, 0.8%), Chest pain (N = 37, 0.3%), Dizziness (N = 21, 0.3%) and 4 patients presented with GI bleeding.

3.3. Admission and Disease Severity

The hospitalisation was taken as an index of severity for this study (Table 2). Hospital admission was required for 7% (N = 811) of the total reported cases, 171 cases (21%) were admitted to ICU and 107 (13.2%) were ventilated. Males represented 81.3% (N = 659) of the total admitted cases, however, the rate of hospital admission among females was relatively higher than among males (8.5% vs. 6.7% respectively, x2 (1) = 7.80, $p < 0.01$) and also among Omanis than Expatriates (8.9% vs. 6.3% respectively, x2 (1) = 23.18, $p < 0.01$). Older age groups tend to have more admission rates than younger age groups (x2 for trend (1) = 478.12, $p < 0.001$). There was no significant difference in the rates of admission among smokers than non-smokers ($p = 0.84$). This finding was consistent even after adjustment for gender. Admission rates were higher among alcoholic (x2 (1) = 4.2, $p = 0.04$) and obese individuals (x2 (1) = 61, $p < 0.01$).

There was no significant difference between mean days of admission neither by gender (531) = 1.69, $p = 0.09$) nor by nationality (t (531) = 0.62, $p = 0.54$).

With regards to rates of "ventilator use" there were no significant gender differences (x2 (1) = 0.14, $p = 0.71$) or nationality differences (x2 (1) = 0.90, p = 0.34). The rates of ventilation tend to increase with age groups (x2 for trend = 156.65, $p < 0.01$). Ventilation was also associated with obesity (x2 (1) = 166.10, $p < 0.01$), Diabetes (x2 (1) = 352.02, $p < 0.01$) and hypertension (x2 (1) = 382.01, $p < 0.01$). Ventilation was not associated with alcohol (x2 (1) = 1.8, $p = 0.18$), nor with smoking (x2 (1) = 1.31, $p = 0.25$).

A multiple linear regression model was applied to identify factors that predict the duration of hospital stay in days such as patient age, gender, and associated co-morbidities. Age, Diabetic status, Obesity and Hypertension were found to be significant predictors after adjusting for other independent variables (Table 3). Patients' duration of admission increased 2.2 days in diabetics, 5.4 days in obese, and by one day per year of age.

Concerning epidemic progression, three-day moving average was used to calculate doubling time. Doubling time peaked around April 25 and declined to remain consistent between 10 to 16 days (Figure 3). Initially, cases were travel-associated with a gradual shift to dormitory and family clusters and after 6 weeks from initial case report community transmission was established.

Table 3. Factors associated with longer duration of hospital stay.

Independent variables	Un-standardized Coefficients (B) with 95% Confidence Interval			Std. Error	Sig.
	B	Lower Bound	Upper Bound		
Patient age in years	0.081	0.030	0.131	0.026	0.002
Diabetes+	2.227	0.457	3.998	0.901	0.014
Hypertension+	1.655	−0.273	3.584	0.982	0.092
Obesity+	5.351	1.969	8.734	1.722	0.002

Dependent Variable: Duration of inpatient days

$R^2 = 0.101$

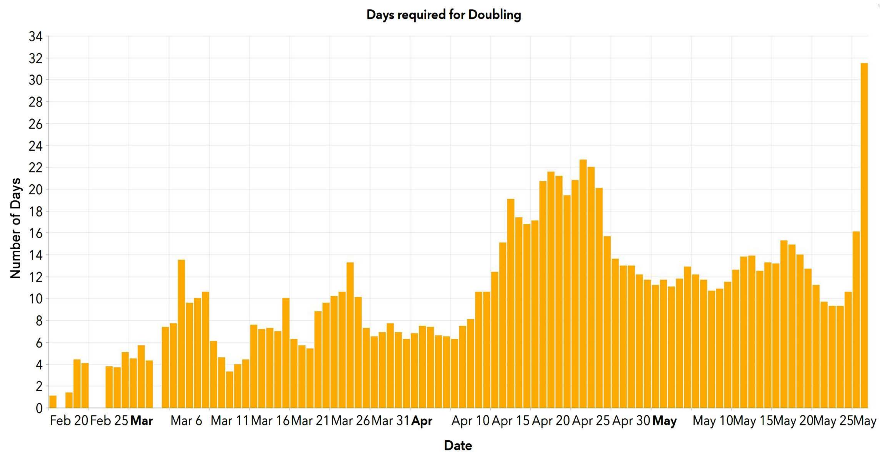

Figure 3. Doubling days of COVID-19 cases in Muscat.

3.4 Cluster Type and Secondary Attack Rates

A total of 158 clusters containing 2949 contacts were identified from case records and were categorised into 3 groups based on their exposure settings. They were workplace (1273 contacts in 56 clusters), dormitory (780 contacts in 26 clusters) and family-household (896 contacts in 76 clusters). A total of 694 contacts among these clusters (295, 201 and 195 in the workplace, dormitory and family respectively) developed symptoms and were confirmed as Covid-19 cases during their quarantine periods (Table 4).

Out of the 694 contacts tested positive, 88 (12.37%) were females and 606 (87.62%) were males (Table 4). The median incubation period measured for workplace, dormitory and family groups was 8 days (IQR 4.0 - 15.0), 8 days (IQR 4 - 17) and 4 days (IQR 2.0 - 7.0), respectively. We attempted to analyse the incubation period of contacts who had symptom onset within 14 days from exposure to the index case to further explore the possibility of significant difference between the three groups taking into consideration the higher possibility of heterogeneity in exposures in workplaces and dormitories. Non-parametric comparison (Mann- Whitney U test) revealed no significant difference in the median incubation period between workplace and dormitory contacts, who developed clinical signs and symptoms of COVID-19 within 14 days. However, a significant difference was found between family vs workplace ($p = 0.0001$) and family vs dormitory groups ($p = 0.002$) (Table 4).

The secondary attack rate (SAR) estimated was highest in dormitory clusters 52% (95% CI: 0.40 - 0.63) followed by workplace clusters 41.6% (95% CI: 0.34 - 0.48), and family clusters 33% (95% CI: 0.27 - 0.38). A statistically significant difference was noted in the SAR among the 3 groups (One-Way ANOVA, $F(2) = 5.43$, $p < 0.01$).

4. Discussion

The pandemic of COVID-19 constitutes a challenge to global public health security. It is the sixth (PHEIC) since the International Health Regulations (IHR)

Table 4. Epidemiological profile of clusters.

Characteristic		Workplace	Dormitory	Family
Number of clusters		56	26	76
Number of listed contacts		1273	780	896
Age group	0 - 5			13 (6.56)
	5 - 13			23 (11.61)
	13 - 21	4 (1.36)		29 (14.64)
	21 - 45	253 (85.76)	165 (82.08)	109 (55.05)
	46 - 60	36 (12.20)	32 (15.92)	11 (5.55)
	60 - 80	2 (0.68)	4 (1.99)	12 (6.06)
	80 - 100			1 (0.50)
Gender	Female	1 (0.33)		87 (43.93)
	Male	294 (99.66)	201	111 (56.06)
Number tested positive among contacts		295/1273 (23.17%)	201/780 (25.76%)	198/896 (22.09%)
Incubation period Median (IQR)		8 (IQR 4.00 - 15.00)	8 (IQR 4.00 - 17.00)	4 (IQR 2.00 - 7.00)
Among contacts tested positive number within 14 days of exposure.		213/295 (72.20)	128/201 (63.68)	183/198 (92.42)
Secondary attack rate, (Mean, 95% CI)		41.60 (95% CI: 0.34 - 0.48)	52.00 (95% CI: 0.40 - 0.63)	33.19 (95% CI: 0.27 - 0.38)

**Other comorbidities reported Cancer (N = 5, 0.04%), chronic kidney disease (N = 18, 0.2%), Dyslipidaemia (N = 21, 0.2%), hypothyroidism (N = 9, 0.1%) and systemic lupus erythematosus (SLE) (N = 2, 0.02%).

2005 has entered into force on 15th June 2007 [17]. According to the IHR, countries should develop their national capacities to prevent, protect against, control and provide public health response to the international spread of diseases and other public health events [18]. However, the implementation phase remains a challenge and countries varied widely in their national core capacities to prevent, detect and control the outbreak, with 28% (52/182) countries had low capacity to prevent public health events and 44 (24%) of countries lacked robust detection capacity. Response capacity to public health events was low in 60 (33%) of countries [19].

The first imported COVID-19 case was reported on 24th February 2020 followed by a steady but slow increase in travel-associated cases. By mid-March, the dynamics of transmission has gradually shifted from imported cases to local transmission.

Various strategic interventions were implemented in Muscat to reduce and flatten the peak of impact. It included the closure of schools and academic institutes, shops and limiting the number of employees in various institutes to 30% and a lockdown of some districts.

The study showed a higher rate of disease among expatriate in the initial phase, however later it affected the Omani population in similar rates. It is to be noted that nearly 64% of the population in Muscat are expatriates. Most of the expatriates are young and blue-collar workers who live in high-density dormitories [16] [20]. This demographic characteristic may explain the distribution of case and males to females' ratio of (6:1). Similarly, the most affected age group was 21 - 40 years, which is driven by the working-age group and it is consistent with other published data.

The median incubation period in our study was 4 - 7 days, which is consistent with other reports from various countries [21] [22] [23]. The main types of clusters identified were family, dormitory and workplace clusters. Initially, the transmission was driven by the dormitory clusters, due to expatriate demography mentioned above, soon followed by workplace clusters. The numbers of family clusters increased with disease transmission getting established among Omani population. The increased incubation period found in dormitories and workplace clusters could be attributed to the larger number of exposed contacts and also due to multiple exposures other than the primary case as it was difficult to segregate workers of each room as they were sharing common amenities. The median incubation period from the family cluster is thus a more valid estimate in our context.

The overall Clinical presentations of most cases were mild to moderate compatible with previously published data [24] [25]. It was noted that the median duration of illness was 5 days for Omanis and 3 days for non-Omanis. Similarly, cough and fever were the main symptoms among the patients included in the study [26] [27]. We noticed at the initial period that patients presented with mild symptoms like rhinitis and headache also reported diarrhoea, anosmia and dysgeusia. Therefore, these symptoms were added later to the case definition.

The Secondary Attack Rate (SAR) for household contact was 33% in our study, similar to other published data [28] [29] [30]. We also noted that SAR was higher for workplaces and dormitories (41.6% and 52% respectively). This again is indirectly a reflection of the population dynamics in middle east countries and Oman is no exception. 75% of the study population were expatriate (most affected in the first 3 months of the pandemic in Muscat), and they cluster together in workplaces and stays in shared dormitories. Besides that, many workers in the large-sized dormitories were sent for screening regardless of their symptoms. Thus, some of the cases in our analysis were asymptomatic. In our dataset, among the clusters, we encountered certain contacts, who developed symptoms 14 days after the exposure to the primary cases. These findings were indicative of the asymptomatic/pre-symptomatic transmission that could have played a major role in dormitory transmission.

Although more than 80% of the hospitalized cases were males, the hospital admission rate was slightly higher among females than males. This was analyzed further by nationality and results were consistent between Omanis and expatriate. This difference could be attributed to health-seeking behaviours and less testing among the female population. Admission rates were also higher among older than younger age groups, alcoholics and obese. There was no significant difference in the rates of admission among smokers than non-smokers. There was no gender nor nationality difference between mean days of hospital admission. Age was positively correlated with the duration of hospital admission.

The majority of patients in our study had good outcomes. However, during pandemics and widespread community transmission, looking at the duration of hospital stay for the admitted patient is critical for planning and predicting countries bed capacity needs. Data on the length of stay (LOS) of patients with COVID-19 in hospital and ICU ranged from 5 days to more than 30 days [31] [32] [33] [34]. From our data, the (LOS) was 9 days, the median hospital stay was 7 days (IQR 1 - 60), median ICU admission was 10 days (IQR 1 - 62) and the median of ventilation was 10 days (IQR 2 - 53).

COVID-19 mortality rate varied across the globe, ranging from less than 0.1% to over 25% [35]. The CFR for our study was 0.9%, a similar rate was reported by GCC countries. However, mortality varies considerably depending on age, socioeconomic status and underlying health conditions. Furthermore, asymptomatic disease prevalence, changes in the case definition and availability and access to testing could lead to an underestimate of infection rate and mortality [36] [37].

Our study has some limitations. The numbers could be an underestimate since a substantial proportion of the population can either be asymptomatic or have mild symptoms for which they do not approach healthcare facility. Language barriers did exist for ascertaining exposure and contact tracing as most cases were expatriates. To overcome this challenge, we did employ contact tracers from various nationalities to address this issue with varying degrees of success.

In conclusion, SARS-CoV-2 is a new virus and understanding the epidemiological characteristics of the affected cases will assist the policymakers to understand patterns of epidemiological spread and thus plan for robust interventions.

Acknowledgements

We would like to thank all head of hospital, heads of health center and private clinic. We thank all focal points in the surveillance team in the Muscat region along with all first line health providers for their dedication and sacrifices.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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